Introduction

EuPRAXIA@SPARC_LAB is a new Free Electron Laser (FEL) facility that is currently under construction at the Laboratori Nazionali di Frascati of the INFN. Fermilab is contributing to the project with the design, manufacturing and qualification of a prototype conduction cooled superconducting undulator (SCU) that, if successful, could be integrated in the final machine. The design of the SCU capitalizes on the extensive experience present at Fermilab on cryomodules. Specifically, the system is based on the warm strongback concept developed for the PIP-II project which enables a modular design with multiple undulator coils integrated in a single vacuum vessel. Here we focus on the overall design concept of the magnet system, its modularity, cost reduction potential and industrialization strategy.

Design parameters

Rail system based on PIP-II proven SRF cryomodule design -> modularity and assembly process improvement.
Cryogenic Design compatible with both conduction cooled (cryocoolers) and LHe operations (SRF CM Style).
Focus on production cost reduction by employing standard commercially available components.
System independent from superconductor technology and coil configuration.
Reduction of cold mass dimensions to improve cooldown time.
Maximization of active length: 1.5 m over 1.8 m.

Cryogenic Design

Cooling: 2 (+ 2) 1.8 W GM coolers.
Reduced vessel diameter to minimize: costs, space and radiation input at 50K.
Integrated G11 support posts allow for mechanical stability and low heat load.
Current leads optimized for higher current heat load. Hybrid HTS/phosphor bronze system.

Prototyping

300 mm yokes reached design tolerances
Comparable tolerances achievable up to 2 m
Extensive use of 3D printed components at cryogenic temperature

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